METHOD AND SYSTEM FOR USING AN ELECTRONIC READING DEVICE AS A GENERAL APPLICATION INPUT AND NAVIGATION INTERFACE

REFERENCE TO EARLIER FILED PROVISIONAL APPLICATIONS

This patent application claims the benefit of

priority from, and incorporates by reference the entire

disclosure of, co-pending U.S. Provisional Patent

5   Application Serial Nos. 60/182,742, filed on February 16,

2000, 60/190,343, filed on March 16, 2000, and 60/192,662,

filed on March 28, 2000.

CROSS REFERENCE TO RELATED APPLICATION

The present application for patent is related to and

10   hereby incorporates by reference the subject matter

disclosed in U.S. Patent Application Serial Nos.

_____ (Attorney Docket No.34650-566PT),

entitled "Specially Formatted Paper Based Applications of

a Mobile Phone"; _____ (Attorney Docket

No.34650-578PT), entitled "Predefined Electronic Pen

5 Applications in Specially Formatted Paper";

_____ (Attorney Docket No. 34650-579PT),

entitled "A System and Method for Operating an Electronic

Reading Device User Interface"; _____

(Attorney Docket No. 34650-601PT), entitled "Method and

10 System for Using an Electronic Reading Device on Non-paper

Devices"; _____ (Attorney Docket No. 34650-

602PT), entitled "Multi-layer Reading Device";

_____ (Attorney Docket No. 34650-604PT),

entitled, "Method and System for Configuring and Unlocking

15 an Electronic Reading Device"; _____ (Attorney

Docket No. 34650-606PT), entitled "Printer Pen";

_____ (Attorney Docket No. 34650-607PT),

entitled "Method and System for Electronically Recording

Transactions and Performing Security Function";

20 _____ (Attorney Docket No. 34650-608PT),

entitled "Electronic Pen with Ink On/ink off Function and

Paper Touch Sensing"; _____ (Attorney Docket

No. 34650-654PT), entitled "Method and System for Handling

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FIFO and Position Data in Connection with an Electronic

Reading Device"; _____ (Attorney Docket No.

34650-655PT), entitled "Hyperlink Applications for an

Electronic Reading Device"; _____ (Attorney

5   Docket No. 34650-656PT), entitled "Measuring Applications

for an Electronic Reading Device"; _____

(Attorney Docket No. 34650-657PT), entitled "Method and

System for Controlling an Electronic Utility Device Using

an Electronic Reading Device"; and _____

10   (Attorney Docket No. 34650-658PT), entitled "Positioning

Applications for an Electronic Reading Device"; and

_____ (Attorney Docket No.34650-673PT),

entitled "Method for Sharing Information Between

Electronic Reading Devices"; and in U.S. Provisional

15   Patent Application Serial Nos. _____

(Attorney Docket No.34650-671PL), entitled "Electronic Pen

for E-Commerce Implementations"; and _____

(Attorney Docket No.34650-672PL), entitled "Electronic Pen

Help Feedback and Information Retrieval"; all filed

20   concurrently herewith.

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BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention relates in general to the communications field, and in particular to an interaction

5 of an electronic reading device with an address pattern.

Description of Related Art

Numerous devices exist for accepting user input and controlling user interaction with desktop and portable computers, personal digital assistance (PDAs), mobile

10 phones, and other types of electronic devices. For example, a keyboard can be used to accept typed input and other types of commands, a mouse or a track-ball can be used to provide relative motion input as well as various types of point-and-click selections, a keypad can be used

15 to provide input of numerical data and functional commands, navigational keys can be used for scrolling lists or otherwise repositioning a cursor, various types of touchpads or touchscreens can be used to provide absolute positional coordinate inputs, and a gamepad can

20 be used for PC and console gaming. Each type of mechanism for accepting input and for supporting user interaction has benefits and disadvantages in terms of size,

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convenience, flexibility, responsiveness, and easy of use. Generally, the selection of a particular type of input mechanism is dependent upon the function of the application and the degree and type of interaction

5   required.

With the ever expanding capabilities and availability of applications both on the Internet and the area of wireless technology, there continues to be a need to develop and provide new mechanisms for accepting input and

10   interacting with users. In particular, some of the existing technologies suffer from drawbacks or limitations, such as size and flexibility, that make them impractical and/or inconvenient to use in some situations. Furthermore, a device application MMI is limited by the

15   physical capabilities of the device. Having several different means of input and navigation for different devices results in higher product costs and a longer learning curve. Language problems can also result from having standardized keyboards, for example. By expanding

20   the range of mechanisms for supporting user interaction, application developers and end-users can have greater flexibility in the selection of input devices. Preferably, any such new mechanisms will provide increased

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flexibility and will maximize user convenience. In
addition, the development of new mechanisms for
interacting with users can expand the realm of potential
applications.

5   For example, while a keyboard typically provides a
great deal of flexibility, particularly when it is used in
connection with a mouse, a touchscreen, or other
navigational device, its size makes it inconvenient in
many cases, especially in the wireless context.

SUMMARY OF THE INVENTION

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The present invention comprises a method and system
for controlling an electronic device. One or more control
functions of the electronic device are represented by
fields on a specially formatted surface. In particular,

15   the specially formatted surface includes an address
pattern. A reading device detects a portion of the
address pattern that is adjacent to the reading device.
Using the detected portion, a substantially precise
location of the reading device relative to the address

20   pattern can be determined. Moreover, by detecting
multiple consecutive positions, substantially precise
movements of the reading device can also be determined.

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If the position and/or movements of the reading device are determined to be within a control field of the specially formatted surface, a corresponding control function can be identified and performed on the electronic device.

5   Using such a configuration, a number of control functions can be executed using the reading device in connection with the specially formatted surface, such as text input, drawing input, navigation, joystick functions and other special functions. These functions can be

10   performed on any type of electronic device capable of communicating with the reading device, including a personal computer (PC), mobile phone, PDA, and the like. Furthermore, by providing a selection or "click" means, particular fields or parts of fields on the specially

15   formatted surface can be selected. Such a selection means can include, for example, a pressure-sensitive means on the reading device, a click button on the reading device, or a detection by the reading device of a portion of a selection field.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, reference is made to the following detailed description taken in conjunction with the accompanying drawings wherein:

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FIGURE 1 is a block diagram of a system in which an electronic pen can be used as an input device;

FIGURE 2 is a schematic diagram of a system for supporting use of the electronic pen described in connection with FIGURE 1;

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FIGURE 3 is an illustration of the protocol stacks that can be used in the case of local communications between an electronic pen and an electronic pen client;

FIGURE 4 is an illustration of protocol stacks that can be used when an electronic pen and an electronic pen client communicate with one another via an Internet connection;

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FIGURE 5 is an illustration of a protocol stack for communications between an electronic pen client and each of the supporting entities when the electronic pen client is not located within a server on the Internet;

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FIGURE 6 is an illustration of protocol stacks that are used for communications between an electronic pen

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client and each of the supporting entities when the
electronic pen client is located on the Internet;

FIGURE 7 is a block diagram of the electronic pen
logic that handles positions, strokes, actions, and grid

5   descriptions;

FIGURE 8 is a block diagram of a state machine for
the electronic pen control block shown in FIGURE 7;

FIGURE 9 is a block diagram of a state machine for an
electronic pen client;

10   FIGURES 10A-10C are a message flow and signaling
diagram illustrating the operation of the electronic pen
system shown and discussed in connection with FIGURE 2;

FIGURE 11 illustrates an example of a specially
formatted paper for PC navigation and input;

15   FIGURE 12 depicts an illustrative example of a
specially formatted paper for cellular phone navigation
and input; and

FIGURE 13 is an illustration of an electronic pen
used in performing an advanced joystick functionality.

20   DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a system in which an
electronic reading device, such as an electronic pen, an

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electronic mouse, or a hand scanner, works in cooperation with an address pattern (e.g., a specially formatted paper) to provide for a detection of a location of the electronic reading device over the address pattern. For

5   instance, a pattern of dots can be defined such that, by examining a very small portion of the pattern, a precise location in the overall pattern can be determined. In fact, it is possible to define a pattern that has the size of 73,000,000,000,000 A4 pages, which is equivalent to

10   half the size of the entire United States. Portions of the pattern can be placed on sheets of paper or other objects.

Then, using an electronic scanner pen that can detect the dots in the pattern, it is possible to detect the location of the pen with respect to the unique pattern.

15   For example, when such a pen is used in connection with a specially formatted paper, the pen can detect its position (e.g., using a built in camera) by detecting a 3 mm by 3 mm portion of the pattern. By taking approximately 100 pictures per second, the pen is capable of determining its

20   exact position to within 0.1 mm or less. This system can be used to provide user input, to facilitate user interaction, or to store handwritten notes or drawings. Moreover, by associating portions of the overall pattern

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with certain applications, such a system can be used to interact with wide variety of applications.

Referring now to FIGURE 1, there is illustrated an example of a system 2 in which an electronic pen 10 can be used as an input device. The electronic pen 10 includes an ink cartridge and is capable of writing in a typical fashion. The electronic pen 10, however, includes some type of sensor (e.g., a built-in camera) that is used for detecting an address pattern on a specially formatted piece of paper 12. In particular, the paper 12 is formatted with a small portion of a large address pattern such that when the electronic pen 10 is used to write on or otherwise make marks on the paper 12, the writings or markings can be electronically detected and stored.

As an example, the paper 12 might constitute a form that can be used for sending an e-mail. Thus, the paper 12 might include a space for writing in the e-mail address of an intended recipient, a space for writing a subject of the e-mail, and a space for writing the body of the e-mail. As the electronic pen 10 is used to fill in each of the spaces, the position and movement of the electronic pen 10 on the paper 12 can be determined by repeatedly detecting the current x, y coordinates of the pen 10

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(e.g., at rate of 100 frames per second). The markings
can then be converted into ASCII text using an appropriate
handwriting recognition program. Once the user completes
the form, the e-mail can be sent, for example, by checking

5   a send box at a predetermined location on the paper 12.

Preferably, the coordinate information collected by
the pen 10 is sent by a short range radio transmitter in
the electronic pen 10 to a nearby mobile station 14 using
a short range radio interface 16 such as a local wireless

10   radio link (e.g., a local wireless radio link supported by
Ericsson's Bluetooth™ wireless communications technology).
Alternatively, instead of using a mobile station 14, the
coordinate information could also be sent to, for
instance, a desktop or portable computer, a personal

15   digital assistant (PDA), a television, or a Bluetooth
terminal. Moreover, instead of using a local wireless
radio link, other types of local wireless links, such as
inductive coupling and infrared light; other types of
radio links, such as Global System for Mobile

20   Communication (GSM); or wired transmission media, such as
a cable can also be used. The information can then be
forwarded via an appropriate link, such as a cellular air
interface 18, to a base station 20 or other network node.

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Referring now to FIGURE 2, there is illustrated a schematic diagram of a system 2 for supporting use of the electronic pen 10 described in connection with FIGURE 1. Throughout the subsequent discussion, the system 2 is

5   described primarily in connection with an electronic pen 10. It will be understood, however, that the invention and the underlying system 2 can instead use any type of electronic reading device, such as an electronic pen, an electronic mouse, or a hand scanner. As shown in FIGURE

10   2, the system 2 includes six different entities, including the electronic pen 10, the electronic pen client 22, a control node 24, a name server 26, a base translator 28, and an application server 30. Although these various devices are described and depicted separately, it is also

15   possible to combine two or more of the entities into the same device (e.g., the electronic pen 10 and electronic pen client 22 can be contained in the same device).

The electronic pen 10 is responsible for detecting positions on the address pattern, producing actions, and

20   sending information to the electronic pen client 22. In addition to being able to leave pen markings, some electronic pens can also have the ability to produce other types of output, such as sound, vibration, or flashing

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lights. The electronic pen 10 includes a memory for storing a current grid, which comprises information relating to an area of the address pattern that is near the most recently detected position of the electronic pen

5   10. When the electronic pen 10 is loaded with the current grid, it knows what actions to take based on the positions that are read from the address pattern. When the electronic pen 10 is first turned on or when it moves to an area outside of the current grid, the electronic pen 10

10   must first request a new grid description before it can continue processing information. In such a situation, the electronic pen 10 requests a new grid description from the electronic pen client 22.

The electronic pen client 22 can be located in a

15   mobile station 14, in a PDA, in a desktop or portable computer, in the electronic pen 10 itself, in a server somewhere on the Internet, or in another device. The electronic pen client 22 serves as the center of communications in the overall system 2. In particular,

20   the electronic pen client 22 receives new grid requests and action requests from the electronic pen 10 and responds to these requests by contacting an appropriate entity within the overall system 2 to properly respond to

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the request from the electronic pen 10. Furthermore, when
the electronic pen 10 is being used in connection with a
particular application, the electronic pen client 22 can
store the application and/or any corresponding data
5   received from the electronic pen 10 to facilitate
processing and use of the application.

The name server 26 is used for translating a detected
position on the address pattern into a Uniform Resource
Location (URL) associated with that position. Different
10   portions of the address pattern are assigned to different
applications. Neither the electronic pen 10 nor the
electronic pen client 22, however, is aware of all of the
different applications and the particular areas assigned
to each application. Thus, when the electronic pen 10
15   detects a new or unknown position, it forwards the
position information to the electronic pen client 22,
which in turn sends the information to the name server 26.
The name server 26 then identifies an application
associated with the received position and retrieves a URL
20   where a description of the particular application can be
found. The retrieved URL can then be used by the
electronic pen client 22 to retrieve the application
description.

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As an alternative, the name server 26 can comprise a global name server that keeps track of a location, in the form of URLs to local name servers, where more information can be found about different addresses in the pattern.

5   Similarly, each local name server can use other local name servers to obtain the necessary information, i.e., to convert a position into a URL where an application description can be found. At the lowest level, the local electronic pen client should know all the paper addresses

10   that are within a specific application or applications.

There are some services that should be available in the overall system 2 for which it is inconvenient or not feasible to support such services in the electronic pen 10 or the electronic pen client 22. In such a case, the base

15   translator 28 can be used to support the services. For example, the base translator 28 might contain handwriting recognition software for converting pen actions into text or for converting pen actions into a predefined set of symbols. When such services are needed, the electronic

20   pen client 22 can send a request to the base translator 28 along with the necessary data, and the base translator 28 can perform the requested service.

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Another entity in the system 2 is a control node 24.
The control node 24 is used for responding to actions in a
standardized way. For example, the control node 24 can be
used to respond to certain generic functions, such as

5 "cancel" or "submit" functions, in a consistent manner
without regard to the particular application that is
currently active.

In addition, the control node 24 is used for creating
streaming-like applications. For instance, some

10 applications might require that the positions on the
address pattern that are detected by the electronic pen 10
be immediately sent, upon detection, to the electronic pen
client 22 for use by the application (i.e., the electronic
pen 10 does not wait to transmit the position data until a

15 complete stroke is detected or until a "send" field is
touched). One example is an application that is used to
control an industrial robot in a warehouse. In such a
case, the application description that is loaded onto the
electronic pen server 22 can include instructions that all

20 positions be streamed to a control node 24. As a result,
the control node 24 can receive the positions in real time
and can control the robot without waiting for the form
(i.e., the current grid) to be completed. Thus, the

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control node 24 can perform a real-time translation from detected positions to a responsive action, such as moving an object (e.g., a robot, a valve, etc.) or controlling a process.

5   The application server 30 is a regular web or wireless application protocol (WAP) server that supports an application associated with a particular area of the address pattern. The application server 30 stores an application description and provides the application

10   description to the electronic pen client 22 upon request. In addition, the application server 30 receives input data from the electronic pen 10 via the electronic pen client 22. For example, the application description might define a number of data entry areas on a form. Thus when data is

15   entered on the form by the electronic pen 10, the data is received by the electronic pen client 22, converted into text using handwriting recognition software, and forwarded to the application server 30, which stores the data or otherwise processes the data in accordance with the

20   function of the application.

Referring now to FIGURES 3 through 6 there are illustrated various examples of protocol stacks that can be used for communicating between the entities shown in

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FIGURE 2. Generally, however, such protocols apply

however, only if the two communicating entities are

implemented in different devices. If two or more entities

are combined into one device, a proprietary protocol can

5   be used to communicate between the entities. FIGURE 3

illustrates the protocol stacks that can be used in the

case of local communications (e.g., using Bluetooth)

between the electronic pen 10 and the electronic pen

client 22. If, on the other hand, the electronic pen 10

10   and the electronic pen client 22 communicate with one

another via an Internet connection, the protocol stacks

depicted in FIGURE 4 will be used. FIGURE 5 illustrates a

protocol stack for communicating between the electronic

pen client and each of the supporting entities, such as

15   the name server 26, the control node 24, the base

translator 28, and the application server 30, when the

electronic pen client 22 is not contained within a server

on the Internet (e.g., such as when the electronic pen

client 22 is located in a mobile phone 14). Finally,

20   FIGURE 6 depicts the protocol stacks that are used when

the electronic pen client 22 is located on the Internet.

There are a number of procedures that can be used by

the various entities in the system 2 to allow the system

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to operate properly. When the electronic pen 10 detects a position on the address pattern that is not within its currently loaded grid or when the electronic pen 10 has no currently loaded grid, the electronic pen 10 initiates a

5   new grid procedure. The new grid procedure involves sending a new grid request object to the electronic pen client 22. The new grid request object contains the newly detected position, a description of the actions that the electronic pen 10 can natively support, and a description

10   of the output signals that the electronic pen 10 supports. The reply to a new grid request object is a grid description, which can be provided by the electronic pen client 22 from its own internal memory or from the information provided by an application server 30.

15   Generally, the electronic pen client 22 extracts the grid description from an application description received from the application server 30. The grid description should only contain action-field-types that the electronic pen 10 has indicated that it natively supports, which means that

20   the electronic pen client 22 in some cases should convert the extracted grid description into a format that the electronic pen 10 can understand.

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In some situations, it may be necessary for the electronic pen 10 to unload its current grid at the request of the electronic pen client 22. In such a case, the electronic pen client 22 sends an empty grid

5   description to the electronic pen 10, thereby causing the electronic pen 10 to unload its current grid. This can occur, for example, when a particular application is complete or when a new grid description request received from the electronic pen 10 cannot be fulfilled, such as

10   when the position received from the electronic pen 10 is not registered in the name server 26.

Another similar message is the empty grid description with a grid exception. When the electronic pen 10 requests a new grid description from the electronic pen

15   client 22, the electronic pen client 22 uses the detected position specified in the request to ask the name server 26 for a URL where the application description can be found. If no URL is returned, the electronic pen client 22 can send an empty grid description with a grid

20   exception to the electronic pen 10. The grid exception comprises a rectangle or other shape indicating the area around the detected position where no registered applications can be found. Preferably, the indicated area

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is as large as possible so that the electronic pen 10

and/or electronic pen client 22 know the extent of the

surrounding area that is unassigned and do not have to

repeatedly send requests to the name server 26. Thus, the

5   empty grid description with a grid exception causes the

electronic pen 10 to unload its current grid and also

informs the electronic pen 10 of an area surrounding the

detected position that can essentially be ignored because

its is not associated with any application.

10   The procedure that is used when the electronic pen 10

detects a new position is a find application description

location procedure. This procedure is used by the

electronic pen client 22 to translate a detected position

received from the electronic pen 10 into a URL where a

15   description of an application corresponding to that

position can be found. The procedure involves sending a

request from the electronic pen client 22 to the name

server 26 containing identification of the detected

position. The name server 26 responds by sending a reply

20   to the electronic pen client 22 containing a URL where an

application description can be found or, if the detected

position is not registered in the name server 26,

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containing an indication that no associated application is known to exist.

Once the electronic pen client 22 knows the URL where an application description can be found, the electronic

5 pen client 22 can initiate a get application description procedure, which allows the electronic pen client 22 to retrieve the application description from the application server 30. In particular, the electronic pen client 22 sends an application description request containing a

10 unique ID for the requesting electronic pen 10 and/or electronic pen client 22 to the application server 30 located at the URL address provided by the name server 26. In response, the application server 30 provides an application description object to the electronic pen

15 client 22, which loads the application onto the electronic pen client 22. The application description object is similar to an HTML form with some additions and modifications.

Furthermore, the application description object can

20 be sent from the application server 30 to the electronic pen client 22 in response to a submitted form (i.e., a submission of one completed form might automatically result in a new form being loaded onto the electronic pen

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client 22). A related procedure is the application submit

procedure, which is used by the electronic pen client 22

when the user of the electronic pen 10 selects a "submit"

field in a form. In response to the selection of the

5   "submit" field, the electronic pen client 22 will submit

the form content in accordance with instructions received

in the application description. Typically, the electronic

pen client 22 will submit the form content, in the same

way as a regular web browser, to a URL specified in a form

10   tag of the application description.

When an action that can be handled by the electronic

pen 10 itself is generated, an action procedure is

initiated by the electronic pen 10 to send an action

request object to the electronic pen client 22. If the

15   electronic pen client 22 cannot translate the action into

a field value itself, the electronic pen client 22 further

forwards the request to a base translator 28 for

translating the action into a field value. In response to

the action request object, an action reply object is sent

20   from the electronic pen client 22 to the electronic pen

10. The action reply object contains output information

that indicates to the electronic pen 10 which outputs

signals to use. The output information, however, cannot

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be of type that the electronic pen 10 has previously

indicated that it does not support. In some instances, the

action reply object might contain a new grid description.

In such a case the electronic pen 10 will unload its

5   current grid description and load the new grid

description. Similarly, if the action reply object

contains an empty grid description, the electronic pen 10

will simply unload its current grid description.

The action request object is also sometimes used to

10   specify actions that should be processed by the control

node 24. In this instance, the electronic pen client 22

initiates a control procedure by forwarding the received

action to the appropriate control node 24. As a result,

the control node 24 sends an action reply object to the

15   electronic pen client 22.

The operation of the electronic pen 10 will now be

discussed in greater detail. Each electronic pen 10 has a

unique pen ID, which is sent to the application server 30

when an application description is requested. The

20   electronic pen ID allows the application to identify the

particular user that is using the application and to

distinguish between multiple concurrent users of the same

application, such as when different electronic pens 10 are

being used in connection with separate sheets of paper

that each contain the same portion of the address pattern.

Referring now to FIGURE 7, there is illustrated a

block diagram of the electronic pen logic that handles

5   positions, strokes, actions, and grid descriptions for the

electronic pen 10. The electronic pen 10 includes a

control block 32 for controlling the operation of the

electronic pen 10. A grid description block 34 represents

a memory location that stores a current grid description.

10   At any given time, the electronic pen 10 can be in either

of two modes. In a first mode, a grid description is

loaded, while in a second mode, the grid description block

34 is not loaded with a current grid description.

As the electronic pen 10 moves across an address

15   pattern, the electronic pen 10 periodically (e.g., every

1/100 of a second) detects a position by detecting all of

the dots within, for example, a 3mm by 3mm area. Each

detected position is forwarded (as indicated at 36) to a

position first in first out (FIFO) block 38, which acts as

20   a buffer for temporarily storing the detected positions.

The clocking of the position FIFO block 38 is controlled

by the control block 32 (as indicated at 40).

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The detected position is fed from the position FIFO

block 38 (as indicated at 42) to an in grid detector 44.

The in grid detector 44 retrieves data from the grid

description block 34 (as indicated at 46) and determines

5   whether the received position is within the loaded grid

description. If not, the in grid detector 44 notifies the

control block 32, which in turn initiates a request for a

new grid. When the detected position is within the

current grid, the position is then sent (as indicated at

10   50) from the in grid detector 44 to a stroke engine 52.

The stroke engine 52 converts the received positions into

strokes, which are then sent (as indicated at 54) to an

action engine 56. A complete stroke is created when the

electronic pen 10 is lifted from the paper or when it

15   moves outside of the grid field where the stroke began.

Finally, the action engine 56 converts the received stroke

into an action that can be sent to the electronic pen

client 22. By using grid action-field-types, the action

engine knows which type of action to produce for a

20   specific grid field.

Referring now to FIGURE 8, there is illustrated a

block diagram of a state machine for the control block 32

shown in FIGURE 7. In this figure, events are indicated

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in capital letters, while tasks associated with the event are depicted in brackets. The process starts at step 60 with a start up event 62, which causes the position FIFO block 38 to begin receiving detected positions.

5   Initially, the electronic pen 10 is in a no grid loaded state 64, which means that the electronic pen 10 does not have a grid loaded in the grid description block 34. As a result, the control block 32 generates an outside grid indication 66, thereby causing the electronic pen 10 to

10   send the request for a new grid description to the electronic pen client 22 (i.e., in accordance with the new grid procedure) and to stop the FIFO buffer 38. At this point, the electronic pen 10 enters a waiting for grid state 68.

15   Once the new grid has been received (as indicated at 70), the control block 32 moves to a grid loaded state 72, at which time the new grid is loaded into the grid description block 34 and the position FIFO block 38 resumes operation. On the other hand, if no grid is

20   received (as indicated at 74), at least a portion of the positions stored in the FIFO buffer 38 are erased. Which part of the FIFO buffer to erase is determined by the grid exception area, if any, in the received empty grid

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description. Accordingly, all positions stored in the

FIFO buffer 38 that are within the grid exception area

should be erased. If no grid exception is received, the

stroke associated with the position is erased. In

5   addition, the FIFO block 38 resumes operation and the

control block 32 moves into the no grid loaded state 64.

When the control block 32 is in the grid loaded state

72, a current grid is loaded in the grid description block

34. While the control block 32 remains in this state 72,

10   the position FIFO block 38 continues to receive detected

positions and passes them on to the stroke engine 52 and

action engine 56. Actions produced by the action engine

56 are sent (as indicated at 58) to the electronic pen

client 22 (i.e., in accordance with the action procedure

15   described above).

At some point, an outside grid indication 74 may be

received by the control block 32 from the in grid detector

44. The outside grid event 74 causes the FIFO block 38 to

stop generating new positions. In addition, the

20   electronic pen 10 enters a flushing stroke and action

state 76 wherein the strokes that are currently in the

stroke engine 52 and the actions that are currently in the

action engine 56 are flushed to the electronic pen client

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22. Once the stroke engine 52 and action engine 56 have been fully flushed (as indicated at 78), the electronic pen 10 sends a request for a new grid to the electronic pen client 22 and unloads the current grid. The control

5   block 32 then moves back into the waiting for grid state 68.

As a general matter, the electronic pen 10 may be capable of supporting various different types of output, including audio, such as warning tones; visual, such as a

10   flashing light; tactile, such as vibration; and/or ink. In some cases, it might be desirable to allow the user of the electronic pen 10 to turn off the ink of the pen 10, such as when the electronic pen is being used on a portion of the address pattern that is public or shared or when the

15   user wants to be able to reuse the current sheet of paper.

The electronic pen client 22 will now be described in greater detail. Generally, the electronic pen client 22 is analogous to a regular web browser. It is responsible for loading applications from application servers 30 and

20   for handling input form the electronic pen 10.
Preferably, the electronic pen client 22 is located in a separate device from the electronic pen 10 itself. This is because it is desirable to minimize the size and power

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supply requirements of the electronic pen 10, which will

likely be adversely affected by the processing resources

and memory necessary to support the functions of the

electronic pen client 22.

5   Referring now to FIGURE 9, there is illustrated a

block diagram of a state machine for the electronic pen

client 22. Initially, the electronic pen client 22 is in

a no application loaded state 80. The electronic pen

client 22 recognizes only one signal when in this state

10   80, namely a new grid request from the electronic pen 10.

Such a request causes a load grid indication event 82.

The electronic pen client 22 responds by sending a request

to the name server 26 to translate a position contained

within the new grid request into a URL where the

15   application description can be found (i.e., in accordance

with the find application location procedure). Next, the

electronic pen client 22 enters a waiting for application

description URL state 84. If no URL for the application

description can be found (as indicated at 86), the

20   electronic pen client 22 sends a new grid reply to the

electronic pen 10, wherein the reply contains an empty

grid description with a grid exception. As a result, the

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electronic pen client 22 returns to the no application

loaded state 80.

If a URL for the application description is received

from the name server 26 (as indicated at 88), the

5   electronic pen client 22 sends a request to the

application server 30 to retrieve the application

description (i.e., in accordance with the get application

description procedure). Accordingly, the electronic pen

client 22 enters a waiting for application description

10   state 90.

If the electronic pen client 22 does not receive an

application description from the application server 30 (as

indicated at 92), a new grid reply is sent by the

electronic pen client 22 to the electronic pen 10 wherein

15   the reply contains an empty grid. Thus, the electronic

pen client 22 returns to the no application loaded state

80. If, however, the electronic pen client 22 does

receive an application description from the application

server 30 (as indicated at 94), the electronic pen client

20   22 sends a new grid reply to the electronic pen 10

containing a new grid description, and the electronic pen

client 22 loads the application in its memory. In

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addition, the electronic pen client 22 moves into an

application loaded state 96.

In the application loaded state 96, five types of

actions can be received by the electronic pen client 22

5   from the electronic pen 10. First, a received action can

include a request that the electronic pen client 22 cannot

handle itself, in which case the electronic pen client 22

will send the action to the base translator 28 (as

indicated at 98). The electronic pen client 22 then moves

10   into a waiting for response from the base translator state

100. Once a base translator response 102 is received by

the electronic pen client 22, the electronic pen client 22

updates a current form or other data associated with the

currently loaded application and sends an action reply to

15   the electronic pen 10 with appropriate output information.

Another type of action that the electronic pen client

22 can receive from the electronic pen 10 is a request

that should be forwarded to a control node 24. In such a

case, the action is sent to a control URL specified in the

20   application description (as indicated at 104), and the

electronic pen client 22 enters a waiting for response

from the control state 106. Once a response is received

from the control (as indicated at 108), the electronic pen

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client 22 sends an action reply to the electronic pen 10
with appropriate output information.

A third type of action is a submit form request, in
response to which the electronic pen client 22 will submit
5   the current form to the application server 30 that is
identified by the URL in the application description (as
indicated at 110). The electronic pen client 22 then
enters a waiting for response from the application server
state 112. If the application server 30 responds by
10   sending an empty application description to the electronic
pen client 22 (as indicated at 114), the current
application is unloaded from the electronic pen client 22
and an action reply is sent to the electronic pen 10 with
an empty grid. As a result, the electronic pen client 22
15   returns to the no application loaded state 80. On the
other hand, if the application server 30 responds with a
non-empty application description, the old application is
unloaded from the electronic pen client 22, the new
application description is parsed and loaded in the
20   electronic pen client 22, an action reply is sent to the
electronic pen 10 with a new grid description and with
appropriate output information, and finally the electronic
pen client 22 returns to the application loaded state 96.

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A fourth type of action that can be received by the electronic pen client 22 from the electronic pen 10 is a request to load a new grid. This action occurs, for example, when a position outside of the current grid is detected by the electronic pen 10. When a new grid request is received, the electronic pen client 22 sends a request to the name server 26 (as indicated at 116) and the electronic pen client 22 returns to the waiting for application description URL state 84.

Finally, a fifth type of action that can be received by the electronic pen client 22 is an action that the electronic pen client 22 can handle itself, in which case the electronic pen client 22 updates the current form and sends an action reply to the electronic pen 10 with appropriate output information (as indicated at 118). The electronic pen client 22 then remains in the application loaded state 96. One type of action that the electronic pen client 22 might be able to handle itself is a local application. For example, the electronic pen client 22 might be capable of performing certain basic functions that are defined by a local application. Thus, when the electronic pen client 22 receives a new grid request, the position associated with the new grid request can be

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analyzed to determine if it corresponds to a local

application. If so, the electronic pen client 22 can load

the application description from its local memory, send a

new grid description to the electronic pen 10 without

5   having to communicate with the name server 26 or the

application server 30.

Another action that might be handled locally by the

electronic pen client 22 relates to the selection of

fields within a form. When the electronic pen client 22

10   receives an action, the field that corresponds to that

action receives focus. When this occurs, the electronic

pen client 22 might display the field's value on its

display or output the value by audio. In addition, the

electronic pen client 22 might allow the user to edit the

15   value of the field by means other than the electronic pen

10. Yet another type of action that might be handled by

the electronic pen client 22 itself are actions that

relate to a clipboard function. When a "copy" field is

selected, the value of the field that had focus at the

20   time the copy field was selected is transferred to the

clipboard. Similarly, when a "paste" field is selected,

the value stored in the clipboard is transferred to the

field that had focus at the time the paste field was selected.

Referring now to FIGURES 10A through 10C, there is shown, by way of example, a message flow and signaling diagram illustrating the operation of the electronic pen system 2 depicted in and discussed in connection with FIGURE 2. Initially, the electronic pen 10 detects a first position on the address pattern at step 120 (e.g., at a location on a sheet of paper designated for composing and sending e-mails). At this stage, it is assumed that the electronic pen 10 is in a no grid loaded state. Thus, in response to the detection of the first position, the electronic pen 10 sends a new grid request 122, which contains the detected position information, to the electronic pen client 22. As a result, the electronic pen client 22 sends an application location request 124 containing the detected position information to the name server 26, at step 126. The name server 26 translates the detected position into a URL where an application description that corresponds to the detected position can be found (e.g., a URL address for a server containing an e-mail application), and returns an application location

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reply 128 containing the retrieved URL to the electronic pen client 22.

The electronic pen client 22 then sends an application description request 130, which contains the unique pen ID for the electronic pen 10, to the application server 30. The application server 30 retrieves the application description at step 132 and sends an application description reply 134 containing the retrieved application description to the electronic pen client 22. The electronic pen client 22 then parses and stores the application description at step 136. This step further involves generating a current grid description from the application description and sending the grid description to the electronic pen 10 in a new grid reply 138. The electronic pen 10 stores the received grid description at step 140 and resumes processing of the detected positions. Using the detected positions and the information in the grid description (e.g., so that the electronic pen 10 knows which fields of the e-mail form are being filled in), the electronic pen 10 generates strokes at step 142 and generates actions at step 144 using the stroke engine 52 and action engine 56 shown in FIGURE 7.

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Each time an action is generated that cannot be handled by the electronic pen 10 itself, an action request 146 containing a description of the action is sent from the electronic pen 10 to the electronic pen client 22. At

5　this point, the electronic pen client 22 should determine what type of action has been received so that it can respond to the action in an appropriate manner. First, it is determined whether the action requires the attention of, or otherwise should be processed in accordance with, a

10　local application at step 148. Very basic applications or frequently used applications (e.g., delete entered text), for example, might be stored locally to avoid having to contact another entity. In such a case, the electronic pen client 22 retrieves the local application at step 150

15　and sends an action reply 152, which can contain a new grid description or other appropriate information.

However, if it is determined at step 148 that the received action does not relate to a local application, the process continues at step 154 where it is determined

20　whether the received action requires processing by an external translator (e.g., handwriting recognition). If so, an action request 156 containing a description of the action is sent by the electronic pen client 22 to the base

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translator 28. The base translator 28 processes the action at step 158 and sends an action reply 160 containing output information responsive to the received action (e.g., text corresponding to written characters) to

5   the electronic pen client 22, which can forward the output information to the electronic pen 10 in an action reply 162, if necessary.

If it is determined at step 154 that the received action does not require processing by an external

10   translator, it is next determined whether the action relates to a control application at step 164. If so, an action request 166 containing a description of the action is sent by the electronic pen client 22 to the control server 24. The control server 24 processes the received

15   action at step 168 and, if a response is necessary, returns output information responsive to the received action in an action reply 170, which is forwarded from the electronic pen client 22 to the electronic pen 10 in an action reply 172.

20   Assuming that it is determined at step 164 that the received action does not relate to a control function, it is next determined whether the action comprises a request to submit a form at step 174 (e.g., a selection of a

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"send" area on the e-mail form). If so, an action request

176 containing the data entered onto the form is sent by

the electronic pen client 22 to the application server 30.

The application server 30 processes the form at step 178

5   and sends an action reply 180 containing a new application

description (or an empty application description) to the

electronic pen client 22. The electronic pen client 22

parses and stores the new application description at step

182 and generates a new grid description from the newly

10   received application description. The electronic pen

client 22 then sends an action reply 184 containing the

new grid description. Although not illustrated in the

figure, the electronic pen 10 will typically respond to

the receipt of a new grid description by unloading its

15   current grid description and loading the new grid

description into its memory.

At some point, it is assumed that the electronic pen

10 detects a position that is outside of the currently

loaded grid at step 186. In response to such an event,

20   the electronic pen 10 sends a new grid request 188

containing the newly detected position data to the

electronic pen client 22. In response, the electronic pen

client 22 again generates an application location request

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190 containing the detected position data and sends the

request to the name server 26. The name server 26

determines whether a URL for an application description

that corresponds to the newly detected position is

5 available at step 192.

If so, the name server 26 sends an application

location reply 194 containing a retrieved URL to the

electronic pen client 22, which in turn sends an

application description request 196 containing the unique

10 pen ID for the electronic pen 10 to the application server

30 at the identified URL address, just as previously

discussed in connection with messages 128 and 130. In

this case, however, it is assumed that the application

server 30 determines that the requested application

15 description is unavailable at step 198. As a result, the

application server 30 sends an application description

reply to the electronic pen client 22 containing an empty

application description. In response to the receipt of an

empty application description, the electronic pen client

20 22 unloads the current application at step 202 and sends a

new grid reply 204 containing an empty grid description to

the electronic pen 10. The electronic pen 10 responds to

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the receipt of the empty grid description by unloading the current grid description at step 206.

Another possibility is that the name server 26 determines at step 192 that a URL corresponding to the

5   detected position is not available. In this situation, the name server 26 sends an application location reply 208 to the electronic pen client 22. The reply 208 may simply be empty to indicate that a URL is not available. Preferably, however, the reply 208 contains a grid

10   exception defining the largest area possible around the detected position for which there is no corresponding URL. In response to the reply 208, the electronic pen client 22 sends a new grid reply 210 containing an empty grid description with a grid exception. Upon receiving the

15   reply 210, the electronic pen 10 unloads the current grid description at step 212. Furthermore, assuming that the electronic pen 10 receives and recognizes the grid exception information, the electronic pen 10 may subsequently be able to determine that certain detected

20   positions on the address pattern are not associated with any application without having to send a request to the name server 26 or the application server 30.

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In accordance with the present invention, an

electronic pen 10 can be used in connection with a

specially formatted paper 12 to provide both navigation

and input to any type of electronic device. For example,

5   a particular sheet of paper can be associated with a

specific electronic device. Different areas on the paper

can be associated with different functions. The paper

might have an area or field for drawing input, an area or

field for text input, an area that is divided into special

10   functional buttons necessary for the associated electronic

device, and an area or field for navigation. Which of the

fields the electronic pen 10 is pointing at can be

determined by using a built-in camera or other optical

detector in the electronic pen 10 to detect a portion of

15   the address pattern on the paper. Similarly, the exact

position or movement of the electronic pen 10 within a

particular field can also be determined by detecting only

a small portion of the address pattern that is adjacent to

the tip of the electronic pen 10 as it is used to write,

20   draw, or otherwise contact the paper. Moreover, when the

electronic pen 10 is used for text input, character

recognition can be performed in the electronic pen 10, in

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an electronic device associated with the electronic pen 10
or the particular sheet of paper, or in a server.

Referring now to FIGURE 11, there is illustrated an
example of a specially formatted paper 220 for PC

5   navigation and input. By using the paper 220 together
with an electronic pen 10, both the keyboard and mouse can
either be replaced or their functionalities can be
emulated. The specially formatted paper 220 includes an
address pattern, as discussed above, such that the precise

10   position of the electronic pen 10 on the paper 220 can be
determined by detecting a small portion (e.g., a 2 mm by 2
mm area) of the address pattern. The formatted paper 220
further includes various fields for use in performing
different functions, including a drawing area 222, a text

15   input area 224, a navigation area 226, and a number of
functional keys 228 (e.g., Insert, Home, Return,
Backspace, and the like).

When the electronic pen 10 is used within the
navigation area 226, it emulates the functions of a mouse.

20   Thus, the cursor or pointer on the PC screen follows the
movements of the electronic pen 10. Execution of a mouse
"click" can be done by touching the electronic pen 10 to a
click field (e.g., in the functional key area 228), by

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optical or pressure sensitive detectors on the electronic

pen 10, or by a click button on the electronic pen 10.   In

addition, other types of special fields might be included

on the paper 220, such as a scrolling bar for performing

5   scrolling functions or directional arrows for moving a

cursor or pointer on the PC screen in specific directions.

To perform other types of PC input, the other fields

on the specially formatted paper 220 can be used.   The

text input area 224 is used for writing characters that

10   are interpreted by character recognition software in the

electronic pen 10 or in the PC.   Alternatively, a QWERTY

or other type of keyboard can be included on the formatted

paper 220.   Special functional fields 228 can also be

included for performing PC specific functions, such as

15   Insert, Delete, Home, and the like.   Furthermore, drawing

input is performed using the drawing area 222.

Preferably, the drawing area is kept separate from the

navigation area 226 and the text input area 222 so that an

ink version of the drawing, in addition to an

20   electronically stored version, can be kept intact, if so

desired.

Referring now to FIGURE 12, there is depicted an

illustrative example of a specially formatted paper 230

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for cellular phone navigation and input. The formatted

paper 230 can either be a separate paper or part of the

cellular phone. Such a formatted paper 230 can replace or

emulate the function of a touchscreen, a chatboard, or a

5   traditional keyboard. The specially formatted paper 230

again includes an address pattern that facilitates

determining a precise location of the electronic pen 10 on

the formatted paper 230. In addition, the specially

formatted paper includes a drawing area 232, a text input

10   area 234, a navigation area 236, a phone keyboard area

238, and a number input area 240.

When the electronic pen 10 is used in the navigation

area 236, it can perform the same function as a mouse

(i.e., moving a cursor or pointer that is displayed on a

15   cellular phone display screen) or can perform a two or

four way scroll function. Other special navigation fields

could also be included for performing WAP browser

navigation or fast menu access (e.g., a phone book

button).

20   The electronic pen 10 can also be used in the text

input area 234 and the drawing area 232 to input

handwritten text and handwritten images, respectively.

Such handwritten input can be converted into ASCII text or

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interpreted as a command to perform some other function by handwriting recognition software in the electronic pen 10, in the phone, or in a server. Similarly, phone numbers can dialed by writing the number in a number output area

5   240. Alternatively or in addition, special fields can be included to emulate the function of a complete phone keyboard (i.e., by touching the electronic pen 10 in a field corresponding to each of the digits in a phone number and then touching a "yes" field, a phone number can

10   be dialed). Accordingly, all of the functions, and possibly more, that can be performed with existing phone MMIs can instead be done using an electronic pen 10 and a sheet of paper 230 designed for performing phone control functions but in a simpler and more convenient manner.

15   Referring now to FIGURE 13, there is illustrated an electronic pen 10 for use in performing an advanced joystick functionality. In this case, a certain part of the overall address pattern reserved for use in emulating joystick functions is printed on a formatted paper 242.

20   By using the electronic pen 10 in the joystick area, movements of the electronic pen 10 can be translated into joystick motions and communicated to a game console or PC for use as an application MMI.

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In a preferred embodiment, for example, the joystick functionality is enabled when the electronic pen 10 is placed vertically in the joystick area 242. Thereafter, when the electronic pen 10 is moved, tilted, or rotated

5   while the tip 244 of the electronic pen 10 is in contact with the formatted paper 242, a sensor or camera in the electronic pen 10 can detect a portion of the address pattern adjacent to the electronic pen 10. The detected portion of the address pattern can then be converted, by

10   processing address pattern images detected by the sensor or camera, into data identifying: the current position of the electronic pen 10 relative to the address pattern; the rotation angle of 0 to 360 degrees (as indicated at 246); the tilt angle of 0 to 90 degrees (as indicated at 248);

15   and the amount of pressure between the electronic pen tip 244 and the formatted paper 242. This data can then be sent to a controlled device at a specified update rate to control, for example, an object in a game (e.g., a plane in a flight simulator game).

20   In accordance with the invention, a system that includes an electronic pen 10, or other similar general reading device, and a specially formatted (i.e., addressed) paper 220 or 230 can be used to control any

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electronic device to: (i) execute applications associated
with the paper 220 or 230 on an electronic device capable
of communicating with the electronic pen 10; (ii)
implement the application MMI for an electronic device;

5   (iii) navigate on an electronic device; and/or (iv)
facilitate text, drawing, or functional input to an
electronic device. Furthermore, special functionalities
in the electronic pen 10 or formatted paper 220 or 230 can
permit emulation of a mouse click, a touchscreen tap or

10   motion, pressing of a functional or input key, and/or
other graphical user interface (GUI) functions, such as a
scroll bar.

Although the invention is described in connection
with examples of PC, game console, and cellular phone

15   control functions, the invention can also be used to
control the electronic pen itself, a PDA, calculator,
digital camera, and any other electronic device.
Moreover, the invention can be used to emulate or replace
the functions of virtually any type of MMI, including a

20   mouse, a keyboard, a touchscreen and stylus, a numeric
keypad, a gamepad, and the like.

Although various preferred embodiments of the method
and apparatus of the present invention have been

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illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it is understood that the invention is not limited to the embodiments disclosed, but is capable of numerous rearrangements, modifications,

5 and substitutions without departing from the spirit of the invention as set forth and defined by the following claims. Furthermore, it shall be understood that the terms "comprises" and "comprising," when used in the foregoing Detailed Description and the following claims,

10 specifies the presence of stated features, elements, steps, or components but does not preclude the presence or addition of one or more other features, elements, steps, components, or groups thereof.